

2017

REQUEST FOR PROPOSAL (RFP) FOR
GSAT-11 GROUND SYSTEM

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SPACE APPLICATIONS CENTRE, ISRO



Request for Proposal (RFP)

**Supply, Installation and Commissioning of
GSAT-11 Ground System**

**SPACE APPLICATIONS CENTRE
INDIAN SPACE RESEARCH ORGANIZATION
AHMEDABAD**

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LIST OF ABBREVIATIONS

RFP	: Request for Proposal
RUT	: Remote User Terminal
OFC	: Optical Fiber Communication
COM	: Comprehensive Operation and Maintenance
COMC	: Comprehensive Operation and Maintenance Contract
CAMC	: Comprehensive Annual Maintenance Contract
HVAC	: Heating Ventilation and Air Conditioning
RFEH	: RF Equipment Housing
TWTA	: Travelling Wave Tube Amplifier
HPA	: High Power Amplifier
LNA	: Low Noise Amplifier
ACM	: Adaptive Coding and Modulation
NMS	: Network Manager System
NCC	: Network Control Center
TFSS	: Time & Frequency Subsystem
HMC	: Hub Monitoring and Control
VCM	: Variable Coding and Modulation
CCM	: Constant Coding and Modulation
VNO	: Virtual Network Operator
QoS	: Quality of Service
CIR	: Constant Information Rate
SIP	: Session Initiation Protocol
TCP/IP	: Transport Control Protocol / Internet Protocol
HTTP	: Hyper Text Transfer Protocol
FTP	: File Transfer Protocol
UDP	: User Datagram Protocol
DDR	: Detailed Design Review

Section-1: Introduction to GSAT-11 Ground Systems

1.1 Introduction

Space Applications Centre (SAC) located at Ahmedabad, India is one of the major centers of the Indian Space Research Organization (1), Department of Space, Government of India.

The next-generation Ku/Ka communication satellite GSAT-11 is currently under development at ISRO. It is a High Throughput Satellite (HTS) and its application shall primarily focus on meeting the country-wide demand for satellite based broadband applications.

The ground infrastructure for complete GSAT-11 system will include four (4) Ka-band Gateways (or Hubs). There will be provisions for multiple service providers to share the satellite bandwidth at L-band interface in the gateway stations and provide services to the end users. Each Service provider will have their own network architecture managed by themselves and operating within the designated bandwidth with their remote terminals. Each Gateway will have one, diversity site with a capability for seamless switching to counter outages due to rain fades and provide redundancy. Thus, each of the four Gateways will have one active and one redundant (space diversity configuration, total 8 RF stations).

The Gateways through their common facilities will provide satellite access to one or more service providers on Hire-purchase/ Lease / Rent or any other suitable arrangement. The arrangement of service providers is outside the scope of this document and will be dealt with separately. However, the Gateways shall be suitably configured and equipped to provide full set of features and connectivity to multiple service providers.

This “Request for Proposal” is for “Supply, Installation, Commissioning, Operation and Maintenance of the complete GSAT-11 Ground System Network” comprising all Gateway Stations and related equipment, defined in this document.

1.2 GSAT-11 Ground Network

GSAT-11 Satellite will provide Ku-band user spot beams, covering Indian mainland as well as islands regions (Refer Section-3, Technical Details of Satellite Transponders). The Satellite will also provide Ka-band spot beams for Gateways. Figure-1 shows the overall ground system comprising four Ka-band Gateway earth stations.

The GSAT-11 Ground network will consist of following major components:

- A. 32 Ku-band spot beams over Indian region with frequency and polarization reuse
- B. 8 Ka-band spot beams over Indian region with frequency and polarization reuse
- C. Four interconnected Ka-band Gateways (Main Gateways) using OFC link. each main Gateway will have one diversity site with RF systems.

- D. The Diversity Gateway will be located at a distance of minimum 10 Km from Main Gateway and connected through OFC link.
- E. Ku-band 1.2m VSATs (Remote User Terminals-RUTs)

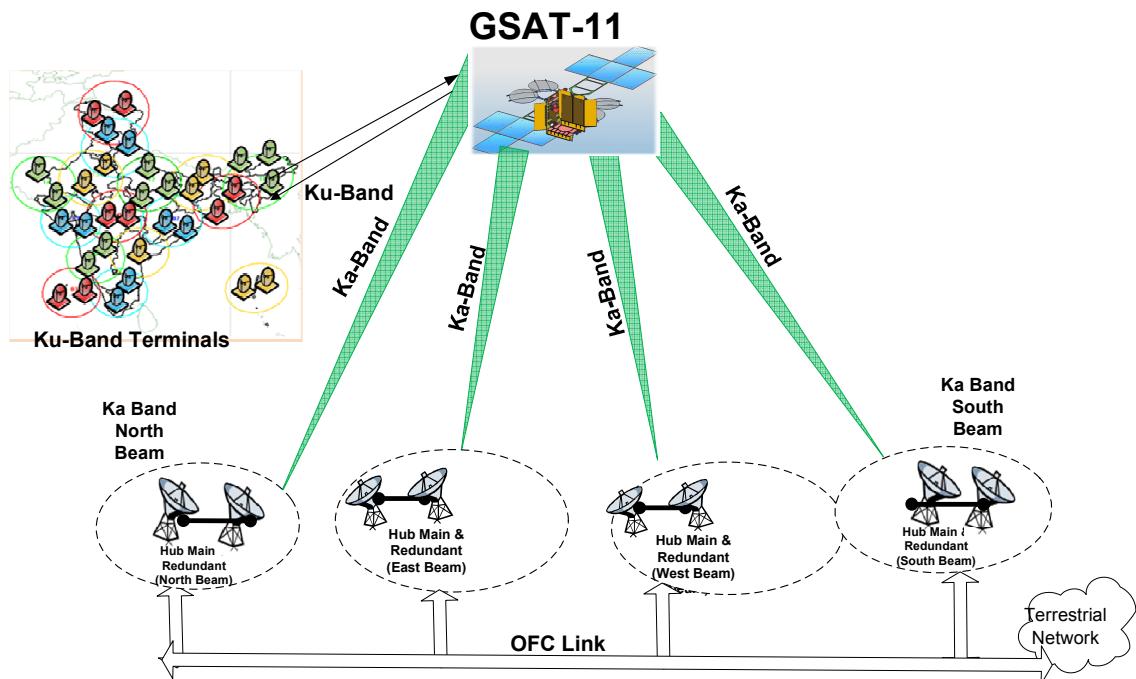


Figure 1: GSAT-11 Ground system

1.3 Network features

1. The Gateways will communicate to Satellite in Ka-band
2. RUTs will communicate in Ku-band with Satellite.
3. Star connectivity between Ku-band RUTs through Ka-band Gateways. The user-to-user communication will only be possible via Gateways.
4. Each Gateway will be connected to the RUTs through eight Ku-band spot beams in both polarizations (four beams in one polarization, total eight beams)
5. All Gateways shall be interconnected through OFC ground network for enabling seamless flow of user data for all India coverage.

1.4 Gateways Description

1. Each Gateway will house number of service providers, who will be allotted satellite bandwidth capacity with access at IF level (L-Band).
2. Each Gateway station will be connected to corresponding diversity stations at L-band.
3. While only RF sub-system will be installed at diversity site, Base band sub-systems will be housed at main Gateway stations.
4. The main Gateways will be the master and should take care of seamless switchover process and delay compensation associated with RF switchover to diversity sites in case of rain fade.
5. The RF systems will have to provide L-band interface to connect multiple (up to 10) baseband equipment housed at Main Gateway stations for establishment of communication network. L band interface connector details (i.e. SMA, N type) will be finalized during DDR. All four Main Gateways will be inter-connected to one-another through OFC links for Pan-India coverage among user nodes.
6. It should be possible to operate the Gateways independently or from a common control site, which may or may not be co-located with any of the Gateways.
7. With respect to baseband, it is planned to establish baseband equipment in each Gateway. The baseband equipment for this portion is part of this RFP.

1.5 Gateway Locations

The Gateways shall be installed at different locations in India. These locations are Ahmedabad, Delhi, Ranchi, and Bangalore. However, the exact location of the site within the places mentioned will be decided at the time of DDR,

Figure- 2 provides a country-wide map of India, showing site locations. Table-1 provides Gateway Geo Location of the sites:



Figure 2: GSAT-11 Gateway Locations

Table 1: Site Geo Locations

Gateway Earth Station		
Place	Latitude (in deg)	Longitude(in deg)
DELHI	28	77
BANGALORE	12	77
RANCHI	23	85
AHMEDABAD	23	72

Section-2: RFP Details and Guidelines

2.1 Scope of Work

The broad scope of work for vendor includes the following:

1. Supply, Installation, Commissioning, Operation and Maintenance of:
 - Main Gateways with their diversity sites – with redundant configuration
 - Baseband system at all the main Gateways for utilization of the satellite
 - 100 RUTs at various locations in the country – the site details will be furnished subsequently.
2. The implementation of the project includes system engineering, associated design and development, supply of hardware & software, installation, integration, commissioning and testing of Gateways.
3. The establishment of basic Gateway infrastructure using state-of-the-art, cost-effective commercially available systems.
4. Installation, commissioning and maintenance of communication network across India using RUTs. The field installation of RUTs as and when requested by SAC.
5. Each Gateway should have L- band interface to support multiple service providers (upto10 numbers) for installation of their respective baseband equipment and creating their own independent communication network with suitable power sharing at L band.
6. The vendor has to provide a warranty for 3 years, which includes comprehensive maintenance with spares for gateways. Vendor also to take up operation of Gateways. Vendor has to quote for operation and comprehensive maintenance including spares for 3 years after completion of 3-year warranty period for gateways. Vendor shall also accept extension of operation and comprehensive maintenance for a period of next 4 years.
7. The vendor shall provide technology and spare support for hardware and software for a period of 10 years. Vendor should also provide policy for procuring spares at the beginning of 10th year for support up to 15 years. Vendor to produce certificate of support from OEM.

8. Purchaser will provide only OFC link between main and diversity gateways (with 1:1 redundancy in two isolated geographical paths) and it is not the responsibility of vendor. However, vendor will have to provide necessary equipment to interface with OFC at main & diversity stations for all gateways, for seamless connectivity among terminals across the entire network as well as connectivity for external services.
9. Vendor should provide connectivity between antenna & baseband using OFC / L- band cable for both main and diversity site.
10. Purchaser will arrange data connectivity between gateways. Vendor should interface their equipment with arranged gateway connectivity.
11. Vendor should supply the test and measurement equipment as per Table-G of Annexure-5.
12. Vendor shall provide one week hands on training on gateway operations and preventive maintenance for 15 persons at no additional cost at one central location.

2.2 Responsibilities of Vendor

Following table-2 defines vendor's responsibilities for entire work involving the establishment & commissioning of Gateway infrastructure.

Table 2 Vendor's Responsibility

Sl. No	Vendor's Responsibility	Compliance	Remarks/Justification
1.	To understand all the requirements and scope of work completely		
2.	Provide system engineering calculations along with the proposed hardware to meet the requirement, as projected in this RFP		
3.	Provide requirement of space for equipment and electricity.		
4.	Submit a comprehensive list of deliverables as per format given in Annexure-5 of this RFP along with the offered price masked for proposed configurations		
5.	Provide detailed cost break-up as part of the offer in the financial bid as per format given in Annexure-5 of this RFP.		
6.	Provide delivery schedule as part of the offer		

7.	<p>Prepare the detailed design review (DDR) document and make presentation during the DDR to the technical committee appointed by SAC. It will be mandatory for the vendor to close all actions generated during this review. Closure of actions will be without impact on cost.</p> <p>This review should also provide system engineering details, protocol details of HMC, Gateway station, RUTs, operational details, monitoring and maintenance considerations etc.</p> <p>Complete Mechanical details (FE Analysis for antenna assembly and support structure against RFP specification viz. Pointing, Tracking, EIRP etc) Racks dimension, Housing details etc.</p>		
8.	<p>Prepare, discuss and submit Acceptance Test Plan (ATP) to SAC. Changes suggested by SAC should be implemented by the vendor during DDR.</p>		
9.	<p>Carry out site preparation and antenna foundation/pedestal and other construction work in consultation with SAC.</p>		
10.	<p>Vendor shall provide the test reports for all sub-systems (eg. Antenna, Feed system, LNA system, TWTA, BUC, BDC, TLT, baseband modems etc.) and get it approved by SAC before dispatch.</p>		
11.	<p>Transportation of equipment to the respective sites.</p>		

12.	Integration of the Hardware and Software.		
13.	Installation, commissioning and testing of the complete ground system including Gateways, RUTs as per the requirements given in this RFP.		
14.	Vendor shall perform acceptance tests as per approved ATP document.		
15.	Supply documentation, relevant OEM certificates, performance report of all subsystems and manuals in hard and soft copies.		
16.	Provide 24x7 technical support as and when required, during the entire tenure of the contract.		
17.	<p>Vendor shall submit comprehensive operation and maintenance plan for services during warranty period of 3 years as per terms & condition given in Annexure-1.</p> <p>After completion of warranty period, vendor must commit to undertake extended comprehensive operation and maintenance services for next 3 years as per terms & condition given in Annexure-1.</p> <p>Vendor must also commit to undertake extended comprehensive maintenance services for additional 4 years,</p>		

	after completing maintenance for 3+3 years, if called for by SAC as per terms & condition given in Annexure-1.		
18.	Vendor shall provide a list of inventory of critical spares along with offer, which the vendor will maintain at his own cost for maintenance of services. The list of the critical spares will be reviewed by purchaser at the time of DDR. Vendor to provide the list of critical spares as per format given in Table-F of Annexure-5		
19.	The selection of the sub-systems of ground system should be done in a manner to ensure the continuity of service for at least 10 years (preferably 15 years) for the Gateway sub-systems. Vendor should also provide policy for procuring spares at the beginning of 10 th year for support up to 15 years. Vendor shall submit comprehensive obsolescence management plan along with offer, substantiated by OEM certificate or a credible alternative strategy.		

2.3 General Guidelines to the Vendors and Other terms & Conditions

1. The offer must contain sufficient data and material to prove that bidding vendor possesses 5 years or more than 5 years of experience as on the date of opening the technical bid in the similar type of work, like handling the project of the similar nature, involving end to end system engineering, design, delivery, installation & commissioning involving large antenna installation as described in this RFP. Vendor should submit the relevant documents clearly and unambiguously stating their previous experiences in executing similar type of work. For antenna hub system, the required experience is as follows:
 - a. Large antenna installations of 7.5 meter and above with tracking system
 - b. Frequency of operation – C/ext-C/Ku- Band or above
 - c. Simultaneous transmit and receive capability including interactive networks

All these above specified experience has to be for the same antenna installation set-up. Thus any antenna hub installation meeting all of the above stated three criterions will only be considered for the experience as similar type of work. **These are mandatory conditions which should be met for qualification of vendor's bid.** The vendor should give the details of experience as per format provided in the Annexure-3. Only those experiences which are backed by relevant unambiguous documentary evidences/proofs will be considered during evaluation. **Experience of OEM alone will not be considered for evaluation.**

- 2. The vendor should have sufficient experience, resources and capability, in India, to execute project of the magnitude proposed in the RFP, involving supply, installation, operations and maintenance. Bidder shall provide documentary evidence to substantiate these.**
3. Vendor shall comply to all the specifications, deviations if any shall be mentioned in a separate table and provide justification how these deviations will /will not hamper the overall performance of the system. Any improvement shall be separately brought out in the offer.

4. The overall configuration and implementation plan should be clearly explained with the help of block schematic of the complete system. The offer should also include the technical justification of choosing each sub-system with respect to the goal of meeting overall system specifications and other requirements.
5. The vendor must provide a Statement of Compliance (SoC), covering each point of system and sub-system specifications of complete earth station system as mentioned in respective sub-system details. SoC by bidder but not supported by OEM or OEM datasheet is not acceptable. **In case of any discrepancy between OEM datasheet and compliance statement, OEM datasheet will be considered final and binding.** This SoC should be well supported by documentation consisting of data sheets, brochure, calculations, literature etc. All relevant details of each subsystem like make & model number, detailed specifications, block schematic, if possible test data sheet etc. should also be provided.
6. After receiving the offers, Vendors will be invited if found necessary to make technical presentation on their offer to an evaluation committee at SAC. Vendors will be required to provide clarification, if called for, by the evaluation committee, on any matter related to offer.
7. Vendors shall also note that the total implementation plan proposed by them should not exceed **12** months from the date of placing the Purchase Order.
8. Vendors may further note that SAC (ISRO) also reserves the right of not considering an offer, if there are any deviations in the commercial and/or general terms and conditions offered against the requirements as per this RFP, even if the offer is technically suitable.
9. **Consortium bidding is not allowed for this RFP.** SAC (ISRO) shall assign the overall responsibility of implementation on a single vendor (prime vendor) for the entire works. Any dependency on any sub-contractors shall be managed by the prime vendor and should not have any bearing whatsoever on SAC (ISRO) and the performance of the final contract. However, the prime vendor must specify the source/partner against the proposed systems and the services which includes information like work/business profile of such a supplier,

experience in executing/supplying similar type of system/subsystem for which the subcontract is **being** awarded, etc.

10. Bidder / OEM blacklisted by any Govt. of India organization is not eligible for participation in the bidding process. The total bid will be summarily rejected involving any of such bidder or OEM in the bid, without any prior notice.

11. The responsibility of safe transportation / delivery of total system to the site rests with the Vendor. This includes:

- (i) Transportation from factory to the site
- (ii) Loading / unloading where applicable during transportation.
- (iii) Transit insurance

All expenditures for above activities shall be borne by the Vendor. SAC (ISRO) will provide custom duty exemption certificate and other such certificates, whenever applicable and requested.

The vendor must project the requirements like custom duty exemption (CDEC) etc. at the time of Bidding.

2.4 Preparation and Submission of Bids

Bids shall be submitted in two separate parts.

Part-1: This part should contain complete technical proposal. This section should bring out complete clarity on the total work involved including conceptualization, implementation and performance. This part should include following information but not limited to:

- a) Heritage of providing similar products and services
- b) Experience details as mentioned in RFP
- c) Technical Compliance Statement (Point by Point Compliance) to **full RFP** including all tables by the vendor
- d) Each Subsystem detail with complete specifications. Vendor must note that multiple OEMs are not allowed for a single subsystem.

- e) Total Network plan along with link analysis.
- f) Implementation details including subsystem I/O interface details, signal flow diagram, level diagram etc.
- g) The level diagram shall indicate the nominal power input and output of each subsystem and should ensure that none of the subsystems e.g. BDC, BUC, LNA etc. goes into saturation.
- h) Simulation results of RF and antenna control system should be provided during bidding / PDR as and when needed.
- i) Complete Civil Work requirements (Antenna Pedestal design, suggested overall building and housing outline drawings, clearly specifying area needed for the Gateway, air-conditioning, electricity, water etc.).
- j) Gateway commissioning, characterization & acceptance test plan
- k) Time Schedule with reference to major milestones
- l) Comprehensive onsite Warranty for three years
- m) Comprehensive Operation & Maintenance plan considering 24x7 uninterrupted operations after completing 3 years of warranty.
- n) This should also include spares policy, plan for preventive and corrective maintenance or any other relevant details during warranty and COMC.
- o) Obsolescence management plan
- p) All papers and documentation of part-2 **Without Price (Price masked)**.
- q) All the sub-systems must be quoted **(Price Masked)** along with make and model number
- r) **Unmasking of the price in technical bid will lead to disqualification of the bid without any further queries**

Part-2: Commercial offer covering entire scope of activity, giving complete cost break-up of each subsystem including integration, fabrication, testing etc. Format for commercial offer is given in Annexure-5.

2.5 Criteria for selection of lowest offer (L1):

Following table gives the item description which are tentatively considered for L1 criteria

Sr No	Item description
1.	Cost of site preparation and civil work for antenna foundation
2.	Cost of Antenna & RF subsystem
3.	Cost of Baseband: Option 1: Cost of Baseband subsystems with configuration of 4+1 (Redundant) Uplink carrier Option 2: Cost of Baseband subsystems with configuration of 1+1 (Redundant) Uplink carrier (Purchaser will select any one option of baseband configuration at the time of technical evaluation of bid and selected option will be considered for L-1 criteria. Therefore, vendor should give the cost of both the configurations.)
4.	Cost of Hub Monitoring and Control (Hardware and Software) System
5.	Cost of 100 Ku-band RUTs including installation & commissioning and onsite maintenance
6.	Cost of Proposed Test and Measurement equipment (specifications as per Annexure-4)
7.	Cost of Comprehensive Annual Maintenance Contract (CAMC) of Gateways for three years after warranty (4 th , 5 th & 6 th years)
8.	On site CAMC of 100 Ku-Band RUTs after warranty, for 4th, 5th, & 6th years
9.	Cost of 24X7 Gateway operation for initial 3 years
10.	Cost of 24X7 Gateway operation for 4th, 5th & 6th year
11.	Applicable taxes

2.6 Delivery & Schedule

- Delivery schedule of the complete earth station system including installation, commissioning and testing shall be defined in the offer by the vendor. Delivery schedule should be 9 months ARO (After Receipt of Order) and 3 months for installation. Hence, total period of delivery, installation, commissioning and testing must not exceed 12 months.
- The delivery schedule must address major milestones including following

Table 3: Time Schedule

Serial No	Major Milestones	Schedule
1.	Detailed Design Review at SAC and Ground System Acceptance Plan Document Submission	
2.	Close out of DDR actions	
3.	Site Preparation (Antenna foundation etc., site wise schedule)	
4.	Delivery of equipment at site	
5.	Antenna & RF installation	
6.	Baseband Installation and Commissioning	
7.	RF System Characterization	
8.	Baseband Characterization	
9.	Total Ground System Acceptance	
10.	Commencement of operations	

Note: Vendor to complete DDR within one month from the date of firm purchase order

2.7 Warranty, Operation and Maintenance

1. The Vendor shall provide comprehensive on-site warranty for a period of 3 years for the complete earth station system and sub-systems from the final date of acceptance as per terms & condition given in Annexure-1. Vendor shall provide the details of spares and maintenance approach for the warranty period for 24/7 uninterrupted operations.
2. The acceptance test is to be conducted with satellite; however, the acceptance test plan should also contain a test plan using TLT for ground system installation excluding antenna and provision for separately measuring or characterizing antenna system.
3. The terms and condition for repairs / services during the warranty period shall be clearly indicated by the vendor while submitting the offer.
4. The detail of COMC is given in Annexure-1

Section-3: Technical Details of Satellite Transponders

3.1 Technical Specifications

The major specifications of Ka x Ku transponders are given below:

Table 4: Ka X Ku Transponder Specifications

Sl No.	Parameter	Unit	Specifications
1	Saturation Flux Density(SFD)	dBW/m ²	-96 ± 2
3	Receive G/T (EOC)	dB/K	16
4	Effective Isotropic Radiated Power (EIRP) (EOC)	dBW	59
5	Polarization Sense		
	- Transmit		LV,LH
	- Receive		LH,LV
6	Coverage		
	- Receive Spot Beams (each polarization)		4
	- Transmit Spot Beams (each polarization)		16
7	Number of Transponders	#	32
8	Usable Bandwidth /Transponder		
	- Per Receive Beam	MHz	464
	- Per Transmit Beam	MHz	116

The major specifications of Ku x Ka transponders are given in Table below:

Table 5: Ku X Ka Transponder Specifications

SI No.	Parameter	Unit	Specifications
1	Saturation Flux Density(SFD)	dBW/m ²	-96 ± 2
3	Receive G/T (EOC)	dB/K	12
4	Effective Isotropic Radiated Power (EIRP) (EOC)	dBW	62
5	Polarization Sense		
	- Transmit		LH,LV
	- Receive		LV,LH
6	Coverage		
	- Receive Spot Beams (each polarization)		16
	- Transmit Spot Beams (each polarization)		4
7	Number of Transponders	#	8
8	Usable Bandwidth per Transponder		
	- Per Receive Beam	MHz	116
	- Per Transmit Beam	MHz	464

Section-4: Technical Specifications of Antenna and RF Subsystems

4.1 Technical Details of Gateway Stations

The representative baseline configuration of the gateway is given in Figure-3. This Section provides details of antenna and RF section of gateway.

Mandatory Features

Each earth station antenna & RF system is proposed to have (but not limited to) the following features:

Table 6: Mandatory Features of Gateway Stations

Sl. No	Features	Compliance (Yes/Partial/ No)	Remarks/Justification (Details of vendor's offer)
1.	Steerable dual reflector antenna system consisting of main reflector diameter ≥ 9.0 m (Nine meter) with four port feed, associated electronics, backup structure, sub reflector, lightning arrestors, HVAC, rain blower, dehydrator, etc.		
2.	Antenna Control System (ACS) with drive electronics including tracking down converter and beacon receiver for satellite tracking		
3.	Antenna foundation, Gateway and Elevation & Azimuth pedestals in El over Az configuration.		
4.	Two receive chains for simultaneous reception of orthogonal linearly polarized signals.		

5.	Two transmit chains (Each to transmit multiple carriers for four beams simultaneously) for simultaneous transmission of orthogonal linearly polarized signals including Uplink power control at IF/RF for rain fade mitigation.		
6.	Redundant RF electronics (LNA, Block Up/Down converters and HPAs).		
7.	Seamless automatic change over from main Gateway to site diversity Gateway for rain fade mitigation. Also, there should be provision for switching between RF and diversity site manually, if required.		
8.	Delay compensation / Network Synchronization system between main & diversity Gateway for uninterrupted communication.		
9.	Time & frequency reference disciplined to GPS with provision for external reference		
10.	L-band IF interface /OFC connectivity with Gateway equipment.		
11.	Centralized Gateway equipment (all RF equipment) Monitoring and Control (HMC) facility with IP based solution for remote operation.		
12.	L- Band Carrier (Transmit & Receive Spectrum) monitoring system to monitor carriers from different service providers either by exclusive instrumentation (i.e. Spectrum analyzer etc.) or by any other solution. Vendors should consider providing this option in the HMC facility. Vendor should provide the mechanism for monitoring at Ka band for both transmit and receive path.		

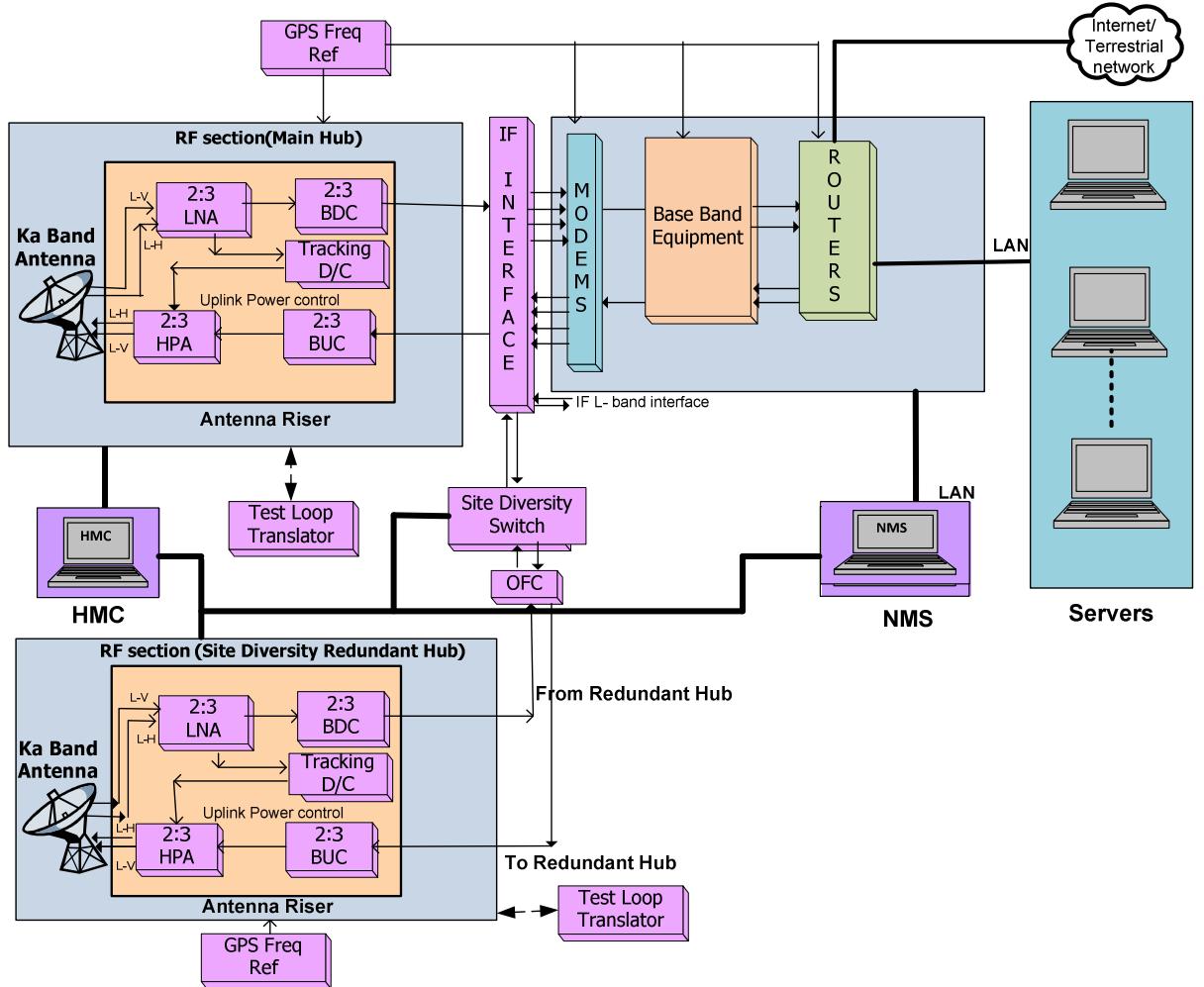


Figure 3: Representative Configuration of Gateway station

4.2 Brief Description

The representative earth station base line configuration of antenna and RF system is shown in Figure-3. It shall have capability to transmit & receive multiple carriers in both linear polarizations at Ka band. The bidders must quote their best solution as a prime quotation and if they like to suggest multiple solutions, the same may be quoted as optional solutions.

As shown in Figure-3, transmit configuration has L- band input signal, which is combination of multiple digital modulated carriers available from base band system. This signal is up converted and transmitted by earth station in Ka- band. The redundancy configuration is 2:3 (two active with one hot standby) for block up converter and TWTA subsystems in order to increase earth station flexibility and availability during equipment failures.

In receive configuration LNA and block down converters have 2:3 (**two active with one hot standby**) redundancy similar to transmit section. The down converted L- band signal is obtained from the output of block down converter, which is given to base band section.

The antenna has 4-port linear feed with HVAC system. Tracking chain contains tracking down converter, beacon receiver, motors, encoders and antenna control unit (ACU) etc with cold redundancy. **The tracking used is monopulse and feed should support it.** Any other sub-systems required for monopulse tracing should be supplied by vendor.

The RF system shall have a test loop translator (TLT) to test the Tx and Rx chain's RF performance prior to testing in satellite. Appropriate test couplers, dummy load and other accessories for the Rx and TX chain are to be supplied by the vendor.

Three types of Link Management Technique (Uplink power controls (ULPC), ACM and Site Diversity) to be provided for rain fade compensation. Bidder should provide recommended sequence and a suitable hysteresis mechanism to avoid frequent in-appropriate switchover in detail.

The uplink system shall have capability for 20 dB (typical) uplink power control with suitable interface. The system should have provision for to/from switching of L-band IF signal for meeting site diversity requirements. The vendor should note that the system should run with multiple outbound and multiple service providers to be integrated with the system.

All RF equipment shall have M&C facility for remote control operation through Computer. Centralized Gateway equipment (all RF equipment) Hub Monitoring and Control (HMC) facility with IP based solution for remote operation shall be provided. Hot redundant HMC system with automatic switchover is to be supplied by the vendor.

The antenna section hosts all RF equipment like antenna and feed, HVAC system, antenna motors, encoders, TWTA (HPA) systems, waveguide switches, attenuators, dummy load, block up converters, LNA subsystem, block down converters, control logic system, time and reference frequency generation & distribution system etc.

Preferably, up link & down link L band signals should be converted to optical signals and brought to the baseband building through OFC for base band equipment connectivity. Alternatively, direct L band interface to base band equipment can also be considered with suitable gain slope equalizer while maintaining the desired levels.

For site diversity switching, OFC link interface for transmit (both: LV & LH) and receive (both: LV & LH) systems is to be provided.

4.3 Gateway Specifications

The major specifications of the gateway station to be complied by the vendor are as given in Table-7.

Table 7 : Gateway System Specifications

Sr No	Parameter	Specification	Compliance (Yes/Partial/No)	Remarks/Justification (Details of vendor's offer)
1.	Frequency of operation (Antenna &Feed) Transmit Receive	29.5 to 30 GHz 27.5 to 31 GHz (Desirable) 19.7 to 20.2 GHz 17.7 to 21.2 GHz (Desirable)		
2.	Antenna diameter	≥ 9.0 meter		
3.	Antenna Mount	Elevation over Azimuth		
4.	EIRP at mid band	86 dBW, minimum in multi carrier mode with Noise power ratio of 25dB in HPA in 29.5 to 30.0 GHz		

		(Provide EIRP break up table in the quote and also provide HPA configuration and sizing details to meet the above minimum EIRP requirement and provide detail block schematic. It must also include feed loss, all coupler loss and HPA assembly loss, if any)		
5.	EIRP Stability Over a day	±1 dB (vendor to provide break up including TWTA gain stability, BUC stability and antenna pointing & tracking errors)		
6.	Transmit Flatness over RF frequency band Full Band Any 40 MHz	$\leq \pm 1.0$ dB $\leq \pm 0.25$ dB		
7.	Up-link power control range	20 dB		
8.	G/T at 20° EL at mid band	39 dB/K, minimum in 19.7 – 20.2 GHz frequency band (Provide break up table in the quote indicating feed loss coupler loss and any other component between feed and LNA system)		
9.	Tracking Mode	Manual, Program & Auto		

10.	Tracking algorithms	Mono pulse		
11.	Polarization (Tx. /Rx.)	Dual Linear orientable (Vertical & Horizontal simultaneous)		
12.	Tx./Rx. Side lobes envelope	ITU-R Rec. S.580-5 (Vendor shall provide Tx/Rx radiation pattern extended cut patterns more than +/-10 deg and ITU mask superimposed over it)		
13.	Peak Pointing error	Maximum Average RMS pointing error should not exceed 1/4 th of 3-dB Rx beam width for winds of 60 km/hr gusting to 80 km/hr (Provide break up in the quote)		
14.	Peak Tracking error	Maximum Average RMS tracking error should not exceed of 1/10 th of 3-dB Rx beam width for winds of 60 km/hr gusting to 80Km/hr (Provide break up in the quote)		
15.	Travel rate of the antenna	Az 0.02 - 0.5 °/sec or better El 0.02 - 0.2°/sec or better		
16.	Acceleration	0.2°/sec ² or better in AZ axis		
		0.2°/sec ² or better in EL axis		
17.	Travel Range	Azimuth: ± 100 deg. contineous		

		Elevation: 5-85 Deg. (0 to 90 deg desirable)		
18.	Angular resolution	Better than 0.001 °		
19.	Polarization movement	Polarization to match spacecraft polarization angle within 1 degree (Linear rotatable: ± 100 deg) through motor with digital display		
20.	Feed Assembly	4-Port, Tx/Rx Linear Polarized; capable of transmitting and receiving both polarization, simultaneously		
21.	VSWR	$\leq 1.35:1$ for both Tx port (29.5 – 30 GHz) and Rx port (19.7 – 20.2 GHz)		
22.	Cross-Pol Isolation (Tx. , Rx)	≥ 30 dB within 1dB beam width		
23.	Power handling capability	≥ 1 KW CW per port (2KW total)		
24.	Port-to-Port Isolation			
	Tx-Tx/Rx-Rx	≥ 30 dB		
	Rx-Tx/Tx-Rx	≥ 85 dB		
Transmit system (Block UP Converter Specifications)				

25.	Input frequency	L-band and compatible to baseband system		
26.	Spectral inversion	No		
27.	Tx. Phase noise	Better than IESS 308/309 standard		
28.	Spurious	65 dBc minimum up to 0 dBm output		
29.	Gain	≥ 30 dB		
30.	Gain control			
	Range	25 dB		
	Step size	0.5 dB or less		
	Group Delay	4 ns p-p maximum over any 40 MHz band		
32.	Tx Frequency Stability			
	Over Temperature (0 to 50 ⁰ C)	$\pm 5 \times 10^{-8}$		
	Over a day	5×10^{-9} or better		
	External Reference Input	10 MHz, auto take over from external to internal in case of external reference failure, for all equipment		
TWTA Specifications				
34.	AM/PM conversion	$\leq 2.0^\circ/\text{dB}$		

35.	Noise Power Ratio	19dB at 4 dB OBO(typical) 22 dB at 5 dB OBO (typical) 25 dB at 6 dB OBO (typical)		
Note: Vendor must ensure that none of the transmit subsystem should operate in saturation				
Receive System (Block Down Converter Specification)				
36.	Output frequency	L-band and compatible to baseband system		
37.	Spectral inversion	No		
38.	Gain	≥ 30 dB		
39.	Gain control			
	Range	25dB		
	Step size	0.5 dB or less		
40.	Receive Gain Flatness over RF frequency band			
	Full Band	$\leq \pm 1.0$ dB		
	Any 40 MHz	$\leq \pm 0.25$ dB		
41.	Group Delay	4 ns p-p maximum over 40 MHz band		

42.	Image rejection	Better than 60 dB		
43.	Rx. Phase noise	Better than IESS 308/309 standard		
44.	Spurious	65 dBc minimum up to 0 dBm output		
45.	Spurious (Signal independent)	-75 dBm maximum		
46.	Rx Frequency Stability Over Temperature (0 to 50 ⁰ C) Over a day	$\pm 5 \times 10^{-8}$ 5×10^{-9} or better		
47.	External Reference Input	10 MHz, auto take over from external to internal in case of external reference failure for all equipments		
Note: Vendor must ensure that LNA should operate 10 dB below 1-dB compression point and none of the receive subsystem should operate in saturation				
Station Reference Timing source				
48.	Time & frequency reference generation	GPS disciplined with a provision for connecting external source		
49.	Frequency	10 MHz		
50.	Level	0 to ± 3 dBm		
Redundancy				

51.	RF equipment	Redundancy for all active system (As specified in section 4.2).		
Test Loop Translator				
52.	Provision to carry out local loop testing	Through Test Loop Translator		
53.	Input Frequency Range	29.5-30.0 GHz		
54.	Output Frequency	19.7-20.2 GHz		
55.	Gain Control	25 dB in 0.5 dB steps		
56.	Third Order Intercept	+18 dBm		
57.	Frequency Stability	$\pm 5 \times 10^{-8}$, over operating temperature 1×10^{-8} /Day typical		
58.	Phase Noise	As per IESS 308/309 standard		
59.	External Reference Input	10 MHz @ 0 dBm ± 3 dB		
Interface between antenna and equipment room				
60.	Link to equipment room	L-band (OFC can be considered)		

61.	Spare IF interface	Transmit/Receive both		
62.	Distance	100 meter typical		
63.	IF Link Equalizer	With 20-dB gain minimum at center frequency, slope adjustment range adequate to equalize the total gain slope		
Site Diversity Link				
64.	Site diversity Link	OFC		
65.	Spare OFC interface	Transmit/Receive both		
66.	Site diversity distance	typically 10 km to 20 km		
Monitoring & Control				
67.	Monitoring and Control	All equipment shall have provision for monitoring and control from local and remote location. TCP/IP interface is desirable		
68.	User interface	GUI		
69.	Operating System	Latest versions of Windows or Linux		
Prime power				
70.	The vendor shall give details of prime power requirement for the antenna and Electronics. The power distribution shall be done by the vendor			

	Note: The prime power available in India is 240V $\pm 10\%$, 50 Hz $\pm 3\%$ for single phase and 440 V for three phase.		
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***Vendor shall provide break up for backup power supply requirement of UPS & DG set for RF system in case of non-availability of prime power for all four sites.**

Note: Figure 3 shows representative base line configuration of gateways. Vendor must provide detailed block schematic of gateways in their technical proposal.

4.4 Antenna System

The antenna system is the outdoor unit and shall be complied for the requirements given in Table-8.

Table 8: Antenna and RF requirements

Detailed Scope of work	Compliance (Yes/Partial/No)	Remarks/Justification (Details of vendor's offer)
1. The Antenna subsystem should include (but not limited to) the following components/items: i. ≥ 9.0 m diameter Ka-Band antenna, drive along with 4-port linear polarization feed with tracking system accessories		

	<p>ii. Appropriate antenna mounts with riser and work platform</p> <p>iii. Rain blower</p> <p>iv. RF Equipment Housing (RFEH) containing all RF Subsystem</p> <p>v. RFEH air conditioning</p> <p>vi. 1:1 Dehydrator system (one operational and another redundant) for antenna, Lightning protection system and aviation alarm lighting. (vendor should provide specifications of dehydrator to meet the requirement to maintain 0.5Psi nominal pressure)</p>		
2.	Carry out soil testing. The test report shall include SBC (Safe Bearing Capacity) and should be presented in DDR.		
3.	<p>The wind loads data, complete mechanical analysis for antenna assembly and support structure for meeting RF specification. These should include the following and presented in DDR:</p> <ul style="list-style-type: none"> • FE Analysis for antenna, antenna RF Equipment Housing (RFEH) behind antenna • Details like foundation bolts size, clearances and interface requirements • Reflector panels and back up structure • Sub reflector fixture and supporting spars • Pedestal, screw, El / Az platform 		

	<ul style="list-style-type: none"> • Provide free vibration analysis with bending and torsion as part of dynamic analysis • Generate time-dependent wind loads from available meteorological data as part of the dynamic analysis, to estimate the dynamic stresses for these time-dependent extreme load conditions. • Final sets of drawings (assembly drawings, interface drawings, drawings related to maintenance of antenna systems and subsystems etc. including soft copy) 		
4.	DDR documents to contain all the important results like maximum stresses in critical members, maximum deflections, and natural frequency of total antenna system etc.		
5.	DDR document should also contain the complete simulation or test result for the antenna system RF performance.		
Alignment Requirements:			
6.	Submit a detailed “alignment plan” with all relevant details in DDR		
7.	Alignment of Azimuth and Elevation axes		
8.	Alignment of reflector panels forming reflector surface		
9.	Alignment of feed and sub reflector with main reflector		
10.	Alignment with respect to true north direction		

11.	Alignment of reflector axis, feed axis, sub-dish axis, shall be carried out.		
	Installation and Commissioning:		
12.	Arrange necessary equipment, tools and cranes/ materials handling equipment required for installation/assembly.		
13.	Carry out civil work for antenna foundation and pedestal after approval from SAC		
14.	<p>The antenna exposed components shall be protected from environment. Vendor shall give details of them as:</p> <ol style="list-style-type: none"> 1. All exposed antenna structural and mechanical parts shall be properly treated and preferably painted white to reflect solar energy and inhibit corrosion. 2. All bolting hardware shall preferably be hot dip galvanized or stainless steel. 3. Dissimilar metals contact shall be avoided unless properly protected against electrolytic corrosion. 		
15.	Suitable electrical drives shall be used for Elevation and Azimuth axes to meet the pointing and tracking requirement. Vendor shall preferably use commercially available drive electronics and provide the information with SAC on the type of drives being proposed for each axis and their specifications/configuration in their technical proposal.		

16.	Antenna system shall have the provision for stow-locks in both Azimuth and Elevation axes. Hand-crank shall also be provided in both the axes for moving the antenna to stow-lock position.		
17.	Lightning arrestors shall also be provided on the reflector for protection against lightning under all pointing conditions. The Vendor shall draw suitable conductors from lightning arrestors to the ground with proper earth pit as per prevailing earthing standards.		
18.	Cable-wrap or any other suitable arrangements to be provided to avoid cable twist during antenna rotation.		
19.	Beacon lights (aviation alarm) shall be provided if required by site regulation		
20.	<p>Antenna RF Equipment Housing (RFEH)</p> <p>The RF electronics should be installed in air conditioned equipment room (RFEH) located immediately behind the antenna reflector.</p> <p>The RFEH layout shall be optimized to provide convenient access with features that increase system availability by providing quick, safe methods to replace electronics without affecting RF performance. This should preferably have the following:</p> <ul style="list-style-type: none"> i) A large roll-up door at the rear of the RFEH to access the RF equipment. The door shall be easy to open. No hardware shall need to be moved for opening the RFEH door. ii) The antenna mount shall be equipped with a large work platform near the RFEH electronics and antenna drives. 		

	<ul style="list-style-type: none"> iii) Integral stairs for safer and convenient access to the platform from the ground. The work platform and stairs should provide access to the jack, motors, data packages, lubrication ports, and antenna Gateway electronics. The work platform shall be fabricated from non-slip, expanded metal. iv) Convenient and level standing surfaces shall be provided in the RFEH at the primary operating elevation angle. v) The HPAs and RF converters shall preferably be mounted on the side walls in the RFEH facilitating feed access. The waveguide outputs of the HPAs shall be mounted in close proximity to the feed waveguide outputs. vi) Tapered alignment pins shall be provided for each HPA, eliminating any tedious adjustments when replacing a unit. vii) All selected RF equipment shall preferably be reliable, commercially off the Shelf (COTS) and not specific to single supplier. The MTBF of supplied equipment from past history shall be made available. viii) To increase electronics alignment repeatability, the HPAs, converters, and switching networks shall be mounted to precision frames in the RFEH preferably. The frames provide repeatable mounting features to eliminate any time-consuming alignment procedures when replacing RF electronics. Identical versions of the frames shall be provided to the HPA and converter. Vendors to assure the dimensional repeatability of the waveguide runs. ix) The air conditioning system shall preferably have local maintenance support. x) Utility outlets and lights shall be provided to aid maintenance in the RFEH. xi) Electrical interface requirement should be 230V/50 Hz AC. xii) The periodic maintenance schedule with time & procedure to be given for antenna & RF subsystem 	
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21.	Vendor should include a detailed “RF equipment housing plan (RFEH)” in the DDR.		
22.	List of Test and measurement equipment for installation, testing and maintenance should be provided by vendor during DDR. Equipment to be arranged by vendor.		

Vendor shall furnish the following details:

SN	Parameter	Unit	Specification
1.	Antenna gain (without feed loss) @29.75 GHz @19.95 GHz	dB _i dB _i	
2.	Feed insertion loss @29.75 GHz @19.95 GHz	dB dB	
3.	Feed VSWR @29.75 GHz @19.95 GHz Worst figure of VSWR in receive and transmit band		
4.	LNA Noise figure (typical) worst noise figure in the receive frequency band along with the frequency	dB dB	
5.	LNA gain @ 19.95 GHz	dB	

4.5 Hub (Gateway) Monitoring and Control (HMC)

Hub (Gateway) Monitoring & Control System (HMC) is a centralized Gateway management tool or set of tools for Gateway /Earth station Equipment. It shall provide the integrated earth station monitoring and control facility during normal operation. The HMC system will be independent of Application/Service provider NMS (base band NMS).

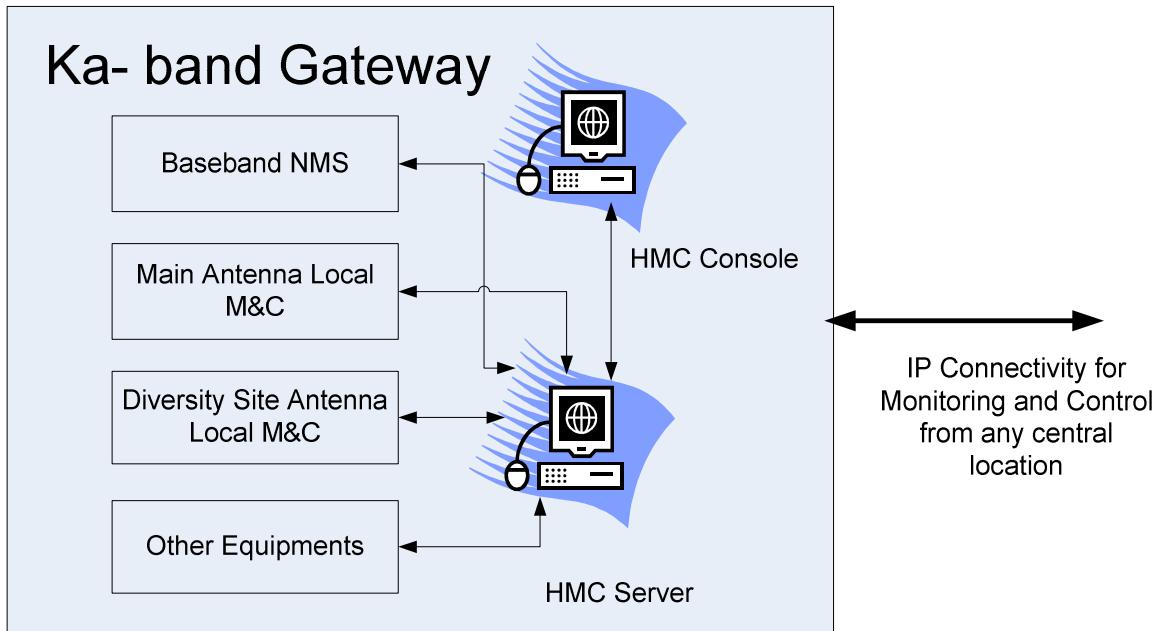


Figure 4: Block Diagram for HMC

Table 9: Features of HMC

Sl. No	Features	Compliance	Remarks/Justification
1.	Architecture: client server, where all back end will reside on server and Gateway operator will be provided a front end console to monitor/manage the Gateway.		
2.	Click and point interface like windows (GUI) for easy control to network operator.		
3.	Web/IP based solution for remote operation		
4.	One HMC per gateway to support the local operations		
5.	Remotely accessible from other Gateway or other remote locations.		
6.	Automatic configuration management to configure earth station for different operational requirements.		
7.	Multi-level authentication/password protection		
8.	Feature level as well as equipment level access right to operators.		
9.	Report Generation based on types of equipment, time of day, specific event, severities, particular users etc.		

10.	GUI to show the live information/ parameters values of the earth station equipment.		
11.	Site Diversity switching management (provide detail sequence of diversity switching)		
12.	Monitoring and display of RF parameter, Antenna control system Parameters, and RFEH environmental parameters with provision for logging of data.		
13.	Provision to export monitored data to some other application for graphical representation or spread sheet		
14.	Self-test facility of complete Gateway during start up and polling of individual subsystem health status during operations or maintenance		
15.	Carrier monitoring at L-band level for in-bound and out-bound carrier of different service providers. Vendor must clearly mention the methodology of carrier monitoring in his quote.		
16.	Display of spectrum and control from user console		
17.	Monitor the carrier of other Gateway to give complete picture at a glance.		
18.	Fully hot redundant system with automatic switchover		

19.	Generation of alarms in all abnormal conditions and also notifications through SMS/Emails etc		
20.	Appropriate virus/firewall protection		
21.	Vendor to give consent for incorporating any changes in HMC during DDR if asked for, without any cost implications.		

Note: Figure 4 shows representative base line configuration of HMC. Vendor must provide detailed architecture & block schematic with different options in the architecture if any. Vendor must quote separate cost break up of different proposed options of HMC architecture, if any.

Section-5: Technical Specifications of Gateway Baseband, NMS and Remote User Terminals (RUT)

5.1 Baseband Requirements

GSAT-11 HTS ground system communication network is designed to provide communication between RUTs in star network topology. The RUT to RUT communication is a two hop communications through Gateway. 1.2m Ku-band RUT's are planned as two-way communication remote terminal. The baseband at Gateways needs to have compatible waveforms with RUT baseband.

Under the present scope, baseband at Gateways has to meet limited capacity of total network capacity. The proposed baseband configuration should be modular in nature and should be expandable to total network capacity, if required. The proposed solution should be DVB-S2x standard compliant.

The baseband hardware requirement includes all modem hardware (preferably card based modular architecture), router, switches, IP-encapsulators, timing synchronization subsystem (for MF-TDMA) etc. for the smooth functioning of network and supported applications.

The Network controller and NMS at the Gateway should monitor and control all the designated baseband subsystems. The NMS should have Virtual Network Operation capability for extending management of network features to more than one application and also support carrier management between various applications.

5.2 Features of Gateway Baseband

The Gateway baseband shall include following important features:

Table 10: Features of Gateway Baseband

Sl. No	Baseband Features
1.	Baseband should have modular architecture, expandable to total network capacity
2.	<p>Baseband with hot redundancy 1:1 for critical equipment (NCC, NMS Server, etc.)</p> <p>NCC Application Servers: 1:1</p> <p>NMS Database/Mgmt Servers: 1:1</p> <p>TFSS (Time & Frequency Subsystem): 1:1</p> <p>Option-1 of 4:1 and option-2 of 1:1 for modulator, demodulator, network accelerator and router as OEM guideline.</p> <p>Forward Link Systems (FLS): N:1 or N:M</p> <p>Return Link Systems (RLS): N:1 or N:M</p> <p>Network Accelerators: N:1 or N:M</p> <p>IP Routers and Switch: 1:1 or N:M</p>
3.	Reconfigurable hardware to support scalable features for the service providers
4.	Forward Link with DVB-S2x, Adaptive Coding and Modulation (ACM)
5	Return link based on MF-TDMA
6.	Time and Frequency Subsystem (TFSS) or similar system to generate timing information for remote and to support seamless switchover to redundant Gateway
7.	Baseband should be capable to adjust the optical delay line for Gateway switching to diversity station with adequate resolution to meet system requirement. Resolution to be specified by vendor with calculation.

8.	Link Management Technique (Uplink power controls (ULPC) and ACM. The sequence to be specified and a suitable mechanism to avoid frequent inappropriate switchover
9.	Baseband with IP Interface and shall support features like TCP acceleration (includes acceleration for all TCP types like HTTP, FTP and TELNET etc.) and other IP optimization techniques to maximize throughput
10.	Baseband will support Web Browsing, Email, VoIP, Video conferencing, FTP etc. and baseband include necessary interface and routers for supporting VOIP gateway, video conferencing system.
11.	Efficient bandwidth management & in-bound access mechanism (Could be a combination or enhancement of schemes like Committed Information Rate (CIR), Bandwidth on Demand, best effort service etc. to support variety of applications and remotes)

5.3 Specification of Gateway Baseband

The technical specification of baseband at Gateway is given below:

Forward link – 1.5 Msps to 45 Msps Single Carrier in each beam with upgradable option up to 110 Msps.

Return link – Configurable 4 to 16+ Return carrier in each beam with aggregated 16 Msps with upgrade option of 90+ carrier with aggregated 90 Msps.

Vendor should ensure that quoted system should support upgrade option at the time of bid

Table 11: Technical Specification of Gateway Baseband

Sl. No	Description	Specification
1.	Network Topology Support	Star
2.	Access Method	DVB-S2x outbound and MF-TDMA inbound
3.	Number of Gateway Baseband System	4
4.	No of Carriers at each Gateway 1. Out-route Carriers 2. In-route Carriers	Option-1: 4 Nos. of Out-route carrier & 1 redundant from each Gateway upgradable up to 8 Nos. Option-2: 1 Out-route carrier & 1 redundant from each Gateway upgradable up to 8 Nos. Each out-routes in each beam to associate with multiple in-routes carriers (from 4 to 16 or higher) with aggregated throughput of 16 Msps or higher. With upgrade option of 90+ carrier with aggregated throughput of 90 Msps or higher
	Outbound Link	
5.	Format	DVB-S2x with ACM
6.	Output Frequency	L-band and compatible to RF
7.	Modulation	ETSI EN 302 307 -2 (DVB-S2x) compliant QPSK 8PSK 16APSK 32 APSK
8.	FEC	ETSI EN 302 307-2 DVB-S2x compliant

		(LDPC BCH) QPSK @ ½,3/5,2/3,3/4,4/5,5/6,8/9,9/10 8PSK @ 3/5,2/3,3/4,5/6,8/9,9/10 16APSK @ 2/3,3/4,4/5,5/6,8/9,9/10 32 APSK @ 3/4,4/5,5/6,8/9,9/10
9.	Symbol rates	1.5 MSPS to 45 MSPS or higher (programmable in steps of 1 MSPS or better) with upgrade option of 110+ Msps or higher
10.	BER Quasi-error-free as per DVB standards	ETSI EN 302 307 -2 (DVB-S2x)
11.	Spectrum and carrier spacing	1.05 x Symbol Rate or better
Inbound Link		
12.	Input Frequency	L-band and compatible to RF
13.	Access Scheme	MF-TDMA
14.	Bandwidth allocation schemes	BoD (Bandwidth on demand) CIR CIR Reallocation Best effort
15.	Modulation	QPSK & 8 PSK or equivalent Modulation
16.	FEC	TPC/Turbo Codes/LDPC or equitant
17.	Inbound channel Symbol Rate	512 Ksps to 4 Msps or higher with subsequent step should not be more than 2 times of previous one. 256 Ksps to 4 Msps (desirable)

Interface		
18.	Tx/Rx	L-band and compatible to RF
19.	Connector	SMA or N type preferable
20.	Output Level	0 to -30 dBm typical (Should be compatible to Gateway RF system) Note: Baseband should be adjustable to provide required level to RF system.
21.	Input Level	-130 to -105 dBm/Hz typical (Should be compatible to Gateway RF system) Note: Baseband should be adjustable to set level available from RF system.
IP Traffic		
22.	Physical Interface	RJ45, 10/100/1000 Mbps Ethernet (separate for data & M&C)
23.	Protocols supported	All popular protocol like IP v4, IPv6 TCP, UDP, IGMP v1, IGMP v2, RIP, SIP etc should be supported.
24.	TCP acceleration, compression and HTTP acceleration & web caching	Required with PEP
25.	IP Multicast	Should be Supported for inbound and outbound traffic
26.	NAT	Required (via Gateway router or NAT manager)
27.	IP Header Compression & other bandwidth optimization features	Required (vendor to specify all the features)
28.	IP QoS on Inbound and Outbound	Required; Multilevel and service wise QoS Priority: Terminal and Group wise
29.	VLAN tagging	Required

30.	LAN/WAN Routers	In redundant configuration to provide interface connectivity to internet and other gateways HUB baseband .
	Network Management	
31.	User Interface	GUI NMS
32.	Network Control Center	Network Control Center (NCC) software to provide management and control over the VSAT network system with NMS running on other Server.
33.	Network Management System (NMS) features	<p>NMS Functions includes:</p> <ol style="list-style-type: none"> 1. Carrier Management 2. Network status monitoring 3. Configuration of all network components including remotes 4. Downloading of operational Software to remotes over the air 5. Addition, Deletion, Enabling or disabling of remotes 6. Fault diagnosis and display of alarm 7. Performance Management 8. Traffic Management 9. Account Management 10. Subscribers authentication and management
34.	Quantity of remote terminals in network	<p>Minimum 1000 terminal, support up to 1 lacs or higher.</p> <p>Note: If any license required, please provide the details and quotation in slab of 100, 500, 1000, 2000, 5000, 10000, 20000, 50000 & 1 lacs terminals</p>
	Network Security	
35.	Encryption	AES- 256 bit Control/Data traffic
	Network Security	
36.	Baseband support the Gateway Diversity	YES (included required hardware and software)
	Redundancy	

37.	Available Gateway configurations	<p>Auto Redundant</p> <p>NCC Application Servers: 1:1</p> <p>NMS Database/Mgmt Servers: 1:1</p> <p>TFSS (Time & Frequency): 1:1</p> <p>As per option-1 and option-2</p> <p>Forward Link Systems (FLS): N:1 or N:M</p> <p>Return Link Systems (RLS): N: 1 or N: M</p> <p>Network Accelerators: N:1 or N: M</p> <p>IP Routers and Switch: 1:1 or N:M</p> <p>(As per OEM guideline)</p> <p>(vendor should clearly specify the redundancy philosophy with supporting documents)</p>
Mechanical, Environmental, and Electrical		
32	Operational temperature	0 to +30 degree C (or better)
34	Power Supply	230V± 10% AC, 50Hz (or better)

1.1 Terminal Specification

Remote User Terminal (RUT) which is interactive terminal and consists of an antenna, Outdoor Unit (ODU) and Indoor Unit (IDU). The satellite modem /Router (IDU) should support IP and provide high TCP/IP throughput. It should be scalable and flexible to provide all functionalities of traditional broadband networks. It should be an integrated device which includes the satellite modem, IP router, TCP optimization over satellite and QoS / prioritization in one box. The broad specifications of the terminals are given in Table-13 & 14.

Table 12: Ku-band RUT Specifications

Sl No.	Parameter	Unit	specification
1	Antenna Diameter	Meter	1.2
2	Polarization		Linear (Vertical or Horizontal configurable)
3	Transmit frequency	GHz	12.75-13.25
4	Receive frequency	GHz	10.7-10.95 & 11.2-11.45
5	Transmit Power (EIRP at mid band	Watts	4W/48 dBW(typ.) and 2W/45 dBW(typ.)
6	G/T at 20 ⁰ El & midband	dB/K	20 typical (provide breakup in the offer)
7	Symbol rate Rx	MSPS	Up to 110 MSPS or higher and Compatible to Hub baseband

	Tx	MSPS	Programmable 512 Ksps to 4 MSPS or higher Compatible to Hub baseband
8	Modulation & Coding	-	Compatible to Gateway Baseband
	Rx	-	ETSI EN 302 307 -2 (DVB-S2x) complaint
	Tx	-	QPSK & 8 PSK or equivalent with TPC/Turbo/LDPC codes or better and compatible with Hub baseband
9.	Rx Stability	KHz	± 500 KHz
10	Tx Mute	-	Shut off the HPA in case of L.O. unlocked or no 10 MHz reference signal
11	Baseband Physical Data Interface		RJ45, 10/100/1000 Mbps Ethernet
12	Protocols Support		IPv4, IPv6, TCP, UDP, ICMP, DHCP, IGMP, RIP Version 2, Static Routing etc. or equivalent protocol
13	Traffic Engineering (QoS)		Compatible to Gateway baseband (Application based QoS, Minimum CIR, CIR (Static and Dynamic), Rate limiting etc)
14	Primary Power		230V $\pm 10\%$ AC, 50Hz.

Section-6: Site Preparation/Civil Work for Establishment of Gateway Stations

6.1 Site Readiness

Site activity is to be done as per table below.

Table 13: Site preparation Activity

Stage	Site Activity	Compliance	Remarks/Justification
PLANNING	<ol style="list-style-type: none"> 1. Obtain available site information from SAC/ISRO 2. Ensure obtaining proper permits. Visit site and conduct detailed site investigation 3. Review, verify, and evaluate site conditions and take photographs. 4. Determine site work required. 5. Perform site land survey, site grading survey, and take soil borings. 6. Measure soil grounding conditions (electrical resistivity and fall-of-potential tests) 7. Document as-built conditions on drawings 		
DESIGN	<ol style="list-style-type: none"> 8. Prepare Site Preparation Requirements and Installment Plan (SPRIP) 9. Document specific site design requirements and discrepancies. 10. Present method of accomplishing work. 11. Present detailed site installation drawings and specifications. 12. Provide installation schedule. 13. Present site photographs. 14. Stage all site material at central staging area. 15. Submit SPRIP to ISRO. 16. Inform ISRO of readiness to proceed with site installation when all permits and material are received. 		

Stage	Site Activity	Compliance	Remarks/Justification
INSTALLATION	<ol style="list-style-type: none"> 1. Receive notice to proceed from SAC. 2. Deploy material and implementation team to site. 3. Trench and install conduit from utility demarcations. 4. Antenna Centre point (Lat, Long) marking and true north referencing 5. Install foundations. 6. Install RFEH with electrical work, smoke/ fire alarm system and ceiling, air conditioning 7. Install grounding and lightning protection systems 8. Install equipment racks and configure RFEH 9. Install antenna cabling and interface wiring 10. Implement fiber-optics network interface systems for OFC. 11. Install, commission and test baseband systems, modems, and NMS. 12. Perform acceptance test and commissioning. 13. Assemble and prepare site O&M manuals. 14. Train operators for on-site maintenance and operations. 15. Perform site cleanup and close-out procedures. 16. Provide as-built documentation and training manuals. 17. Conduct final site acceptance for sign-off. 18. Implement warranty support. 		

ANNEXURE-1

Comprehensive Operation, Maintenance Contract (COMC) for Ka-band Gateways

Comprehensive Operation & Maintenance Contract (COMC) for Ka-band Gateways and comprehensive maintenance of Ku-Band field terminals

Introduction

ISRO is establishing Ka-band gateways (HUB) and field terminal for utilization of GSAT-11. The gateways are having main and site diversity configuration with site diversity Hub located 10 to 20 Km away from main Hub. There are four gateways with main Hub and site diversity Hub located at Delhi, Ranchi, Bangalore and Ahmedabad.

The main Hub is having Ka-band antenna system with RF electronics interface at L-Band and similarly site diversity Hub is having similar antenna & RF configuration. Main Hub is also having base band system interface at L-band.

The network consists of followings.

- 1) Gateways (Main with site diversity)
- 2) RUTs (Remote User Terminal)

Scope of Work

Techno-commercial proposals from vendors are invited to provide Comprehensive on Site Maintenance Services for GSAT-11 VSAT network and operation of Gateways. Vendor has to carry out following activities.

- 1) Comprehensive On Site Maintenance Services for four Gateways (Main & Diversity Hub)
- 2) Gateways operations on 24 X 7 basis
- 3) Comprehensive On Site Maintenance Services for RUTs

PERIOD OF CONTRACT:

The vendor has to execute maintenance as a part of 3-year warranty period as per the requirements in this RFP. The vendor has to quote for 3 years operations & maintenance of the gateways for 3 years after the completion of warranty period which will be extendable for additional 4 years on pro-rata basis with similar terms & conditions. In case of the RUTs, the maintenance will be done for 3 years' period after the initial 3-year warranty period.

Activities to be carried out by Vendor

The vendor has to carry out following activities.

1. Comprehensive Annual Maintenance

- 1.1 The vendor shall carry out On Site Comprehensive Maintenance Services for Gateway located at Ahmedabad, Delhi, Ranchi & Bangalore and RUTs spread all over India.
- 1.2 The details of equipment at Gateways, RUTs are as per supply contract of this RFP. The address details of Gateways, RUTs will be made available at the time of installation.
- 1.3 The vendor should have representative/offices located by zone wise in India for easy interface with party and should have toll free number/Phone and Fax numbers to get immediate attention for breakdown calls.
- 1.4 Preventive maintenance (PM) for gateway would be done every three months and RUTs equipment every six months during the period of contract, where subsystems will be thoroughly checked, serviced and adjusted. A comprehensive PM report against each gateway shall be submitted to SAC. The format of the report will be jointly finalized at appropriate time.
- 1.5 After every visit, the service engineer should take the signature of the custodian of the site with photograph and RF spectrum plot of the fully installed gateway.
- 1.6 Only installed RUTs need maintenance.
- 1.7 The vendor has to prepare detailed maintenance report for each maintenance activity carried out for Gateway and RUTs.
- 1.8 The maximum acceptable down time for gateway is 4 Hour and 5 days for RUTs

2. Gateway Operations

- 2.1** The vendor shall operate the Gateway on 24X7 basis.

2.2 Gateway has to operate on round the clock basis. 3 Shifts (Two Engineers per Shift) of 8 Hours are to be organized per day for gateway. However, SAC reserves the right to alter this requirement based on operational requirements.

2.3 The manpower to be deputed for the operations of gateway shall be reasonably experienced trained manpower.

2.4 The vendor shall submit the Bio Data and two copies of pass port size photographs to ISRO of the personnel being deputed to operate the gateway. Vendor shall be willing to furnish the police verification and similar credentials if warranted.

2.5 Engineers recruited should be experienced and well trained in the operations of gateway.

2.6 Engineers should be capable of managing the network activities end to end.

2.7 Gateway Operations includes activities like but not limited to following activity

- 1) Monitoring of Gateway
- 2) Monitoring of entire VSAT Network
- 3) Attending to Alarms and faults
- 4) Configuration management as per approved SOP
- 5) Support for installation of terminals
- 6) Gateway and terminals configuration management
- 7) Interfacing with external agencies & user agencies with respect to operations of the Gateways.
- 8) Fault finding & correction in case if gateway is down / non operational
- 9) Co-operating with field team visiting for maintenance / fault finding
- 10) Preparation of operational / status reports
- 11) Submission of reports to concerned authorities.

2.8 Gateway engineers shall be equipped with mobile facility and their contact details are to be forwarded to ISRO.

2.9 Engineers deployed for the gateway operations shall attend the gateway on their own transport arrangement and no conveyance charges will be paid by ISRO.

2.10 Engineers deputed for gateway operations shall not be changed without prior approval from ISRO. If engineer deputed is not found suitable, vendor shall replace manpower as directed by ISRO in reasonable time frame.

3. Terms & Conditions

3.1 All Vendors has to provide certificates of OEM (Original Equipment Manufacturer) for the equipment used in GATEWAY, RUTs to support maintenance activity related to

Gateway, RUTs during COMC period. Offer received from the Vendor without providing above certificate will be treated as cancelled.

- 3.2** During CAMC period vendor should accept any addition or deletion of RUTs for CAMC on pro rata basis on same rate.
- 3.3** The term comprehensive means Vendor will diagnose repair / replace the faulty component / system / peripherals / software and OS installed for Gateway & remote nodes with its own resources and equipment within given time frame, make system operational and all expenditure related to COMC has to be borne by Vendor.
- 3.4** All logistics like arrangement of required transport of equipment and lodging / boarding for maintenance personnel will be the responsibility of Vendor.
- 3.5** In the event of the damages to user's property or personal injury to user / Vendor personnel due to the negligence of employee of Vendor, the responsibility shall be solely rest with vendor. ISRO shall not be responsible for the loss of life of employee of Vendor at the time of performance of contact at user agency's premises due to natural calamities / accident explosion etc, if any, the persons engaged by the Vendor for carrying out the maintenance work will not have any right or claim for regular employment in any of the ISRO / DOS and these establishments.
- 3.6** For any problem reported by the user, the problem shall be attended within 4 hours for Gateway and 5 days for RUTs in the mainland. For Remote stations (North Eastern, Andaman), the problem shall be attended within 6 days. Parts / equipment replaced duly repaired should be of same type & capacity. In case any part is replaced by lower capacity; the original capability should be restored within 3 months. In case of non-availability of identical replacement, suitable new equivalent replacement with similar or better specification should be carried out with approval of SAC.
- 3.7** Replacement of defective spare parts shall be arranged by vendor at no extra charge. The replacement shall be a new part or equivalent functional unit. In case maintenance is held up for spares and if the system is not working, corresponding amount for each system, which is non-functional, shall be deducted from the bill.
- 3.8** The faulty part replaced can be taken by Vendor. Vendor should prepare maintenance report for each maintenance activities carried out and sent to the Engineer -in- charge / focal person.

3.9 Vendor should maintain sufficient spares to meet the COMC requirement. Vendor to provide list of spare as per Table-F given in Annexure-5. SAC-ISRO will review list of spare and suggest any addition deletion in the list during DDR. **The cost of spare is to be borne by vendor**

3.10 Vendor should define proper call reporting formats and reporting procedures

3.11 As maintenance is comprehensive in nature, Vendor should stock spares of essential nature or as recommended by manufacture(s). Vendor is required to furnish their spare management plan as part of their proposal.

3.12 Vendor shall be responsible for all types of charges like lodging, boarding, fares etc for visits to gateway and various nodes.

4. Contract Manager

SAC/ISRO will nominate person as Contract Manager for this contract for the purpose of matters related to this COMC. All correspondences shall be marked in his name.

5. Payment terms

5.1 Payment will be made on quarterly basis for Gateways and half yearly basis for RUTs at end of each quarter/Half year after completion of satisfactory service.

5.2 The bill duly certified by SAC ISRO Nominated personal shall be submitted to Accounts officer, SAC, Ahmadabad for payment.

6. Penalty Clause / LD Clause

6.1 The down time is 4 hours for Gateway. The faults reported / lodged from the user must be attended and repaired 4 hours from the time of report of compliant. For each subsequent hour of delay after 4 (four) hours from the time of lodging the compliant, 0.5 % of annual COMC value with ceiling of 10 % of total contract COMC value of gateway.

6.2 The down time is 5 (Five) days for all types of RUTs. The faults reported / lodged from the user must be attended and repaired within 5 (Five) days for mainland and 6 days for North East, J&K and Andaman & Nicobar from the date of report of compliant. For each subsequent day of delay after 5 (Five)/6(Six) days from the date of lodging the compliant, 0.5 % of annual COMC value per day will be recovered from the bill with ceiling of 10 % of total annual COMC value.

7. Arbitration

Dispute, if any, shall be settled mutually, failing which it shall be referred to a one-man arbitrator appointee by the Director, SAC, Ahmedabad in accordance with Arbitration Act 1996, whose decision shall be final and binding on both the parties.

8. Termination of contract

ISRO reserves the right to terminate the contract if the performance of the Vendor is found to be unsatisfactory during its currency of the contract by giving one month's notice in writing without any financial implications on either side.

9. Fall Clause

The charges for the above work shall in no event exceed the lowest charges at which you service the Gateway of identical description to any other party during the currency of the contact. If, at any time during the said period, you reduce the charges for similar work to any other customer, you shall forthwith notify the same to us and the charges payable under the contract for the service shall stand correspondingly reduced.

10. Force Majeure

Should a part or whole of the services covered in this contact be delayed due to reasons of force Majeure (for sites identified by ISRO) which shall include Lock-outs, strikes, riots, civil commotion, fire accidents, acts of God and war, stoppage of deliveries by Government, refusal of or the training schedules referred in the respective orders shall be extended by a period(s) not in excess of duration of such force Majeure. Each party undertakes to advise the other as soon as it becomes aware of the circumstances of such force Majeure. So that actions under the provisions of those orders can be mutually reviewed and agreed upon between Vendor and ISRO if the force Majeure conditions extend over a period of six months both the parties of the order shall mutually discuss and arrive at an agreement for continuation or termination of the contact.

ANNEXURE-2

Environmental specifications for GATEWAY Antenna and RF equipments

The earth station will be operating under controlled environmental condition. However, the equipments used shall have the capability to following environmental condition.

Table 14: Environmental Specifications

INDOOR UNITS		
1.	Operating Temperature	0° C to +50° C (Hub baseband: 0° C to +30° C)
2.	Storage temperature	-40° C to + 70 °C, desirable
3.	Humidity	95% RH @ 40° C
4.	EMI/EMC	As per IEC, class A equipments
OUTDOOR (EXPOSED) UNITS		
5.	Operating Temperature Range	-10°C to +55° C
6.	Storage temperature	-40° C to +60° C, desirable
7.	Humidity	95% Rh @ 40° C
8.	Rain	As per JSS 55555 or equivalent
9.	Dust	As per JSS 55555 or equivalent
10.	Wind speed Operational Gusting Stowing speed to Zenith Survival wind speed	60 kmph, Min 80 Kmph Min 100 kmph, Min 200 kmph, Min

ANNEXURE-3

Vendor needs to fill the tables below to share their experiences in the relevant field.

Details of Contracts of Antenna (\geq 7.5 meters) and RF installations as per requirement given in section 2.3, Sr. No-1

Table 15: Experience declaration

Name of Customer & contract No if any	OEM	Antenna diameter and BUC/HPA size	Band of operation	Tx /Rx or Rx only/ Tx only	Contract Award date and Completion date

Annexure-4

Specifications of Measuring and Test Equipment

(A). Digital Storage Oscilloscopes 500 MHz Four Channel Color Display

1. General	: The Digital Oscilloscopes shall be rugged and portable with user-friendly front Panels for various types of measurements quickly and precisely. It shall provide Facilities for commonly used automatic Measurements, auto set features, Cursor Measurements IVI Drive.
2. Real Time Bandwidth	: DC-500MHz simultaneously on all channels
3. No. Of Channels	: Four Channels
4. Sample Rate	: 2 GS/s on all Channels simultaneously
6. Vertical Resolution	: 8 Bits
7. Vertical Sensitivity	: 2 mV/div to 5 V/div.
8. Time Base Range	: 1ns to 50 sec. per division
9. Time Base Accuracy	: +/- 15ppm
10. Waveform Capture Rate	: 100000 waveform/sec.
11. Sweep Mode	: Auto, Normal and Single Sequence
12. Max.Input Voltage 1M ohm	: 150 Vrms
13. Input Coupling	: AC, DC, GND
14. Triggering	: Edge, Pulse Width, Logic, Rise/Fall Time, Video, 12C, SPI, Auto, Normal and Single, Trigger markers
15. Acquisition Modes	: Sample, Peak Detect, Averaging, Hi-Resolution,
16. Measurements	: 25 Automatic Measurement, (4 can be displayed on screen at any one time), Measurement Statistics, Reference Levels, Gating, Math (Add, Subtract, Multiply and Divide Waveforms), FFT, Math Functions Integrate, Differentiate, Advanced Math- Define extensive algebraic expressions including waveforms, math

functions, scalars, up to two user adjustable variables and results of parametric measurements.

17. Display	: Colour Display, 8.0 inches LCD TFT,
18. Interpolation	: Sin x/x
19. Format	: YT, XY
20. Power Supply	: 230 +/- 10% Volts, 50 Hz. AC Supply
21. I/O Interface	: USB, LAN Port
22. Operating Conditions	: 10 to 40 degree C and humidity of 80% at 30 degree C
23. Standard Accessories	: 500M Hz Probe one per channel, Front Cover, User to be supplied Manual, Calibration Certificate, Power Cord & Accessories Bag etc.

(B). Spectrum Analyzer

Frequency Range	: 9 kHz to 40 GHz
Frequency Counter	
(a) Resolution	: 1 Hz Min.
(b) Frequency span	: 0 Hz (zero span), 100 Hz to 40 GHz
(c) Max. Span Accuracy	: 1%
Spectral Purity	
(a) SSB Phase Noise @ 10KHz offset: <-90 dBc/Hz at 1 GHz	
(b) Harmonics, @ -40dBm level	: ≤ -60 dBc
Sweep time	
(a) Span ≥ 10 Hz	: 2.5 ms to 1000 s
(b) span = 0 Hz	: 10 micro s to 2000 s

Bandwidth

(a) Resolution Bandwidth (-3dB) : 10 Hz to 3 MHz in steps

(b) video Bandwidths : 30 Hz to 1 MHz in steps

Amplitude

(a) Max. Input level for Protection : +30 dBm

(b) Max. input level for Measurement : +20 dBm

(d) Displayed average noise level, : <-110 dBm for 10 MHz to 3 GHz (300 Hz RBW, 10 Hz VBW)

<-105 dBm for 3 GHz to 13 GHz

<-95 dBm for 13 GHz to 40 GHz

(e) Quasi Peak Detector : EMI b/w(6dB), 9kHz, 120 kHz

Markers : Normal and delta

Trigger : Free run, Video, External

Traces : Min.3

Display : TFT color display

Interface : USB and LAN

Measurement features : C/N Ratio, Adjacent Channel Power and occupied Bandwidth, Channel Power measurement, Phase Noise Measurement,

Operating Temperature : 10 to 40-degree C temperature and 80% RH at 40-degree C

Power Requirement : 230 +/- 10 % VAC, 50 Hz

(C) RF signal Generator

RF Signal Generator 10 MHz to 40 GHz

1. General purpose, wide frequency range, AM & FM features :

(a) Frequency Range: 10 MHz to 40 GHz

(b) Frequency Resolution: 0.1 Hz

2. Frequency Stability

(a) Ageing Rate for reference frequency: 10^{-6} per year

(b) Temperature stability for reference frequency: 1×10^{-6}

3. Spectral Purity

(a) SSB phase noise at 10GHz on 20KHz off set CW and 1 Hz BW : <-100 dBc

((b) Harmonics at 20 GHZ at level 0 dBm : < -30 dBc

(c) Non Harmonics (>50 KHz carrier offset): < -55 dBc

4. Output Level

(a) Range: -105 dBm to + 5 dBm

(b) Resolution: 0.1 dB

(c) Accuracy (for levels >-100 dBm) at 25 Deg C : $< +/-1$ dB at 10 GHz, 0 dBm

(d) Frequency response at 0 dBm : < 1 dB

(e) VSWR : < 2 at all operating frequencies

5. Modulation shall be AM & FM

(a) Amplitude Modulation: Internal, external

(i) Modulation Frequency Range(3dB), $f > 100$ kHz : DC/ 20 Hz to 20 KHz

(ii) Modulation Depth: 0 to 90%

(iii) AM Distortion at 1 kHz ($m < 80\%$), 0 dBm : $< 5\%$ of reading + 0.2%

(b) Frequency Modulation: Internal, external

(i) Frequency Deviation: 20 to 100 kHz

(ii) Resolution: 1%, min. 1 Hz

(iii) Modulation frequency range (-3dB) standard: DC/20 Hz to 80 KHz

6. Memory: 10 Storage settings

7. Digital Sweep

(a) RF Digital Sweep: Automatic single manual or externally triggered

(i) Sweep range and width (lin) : Freely selectable

(ii) Sweep Time: 30 ms to 1 s with resolution of 1 ms.

(b) RF Analog Sweep

(i) Sweep range: Freely selectable

(ii) Sweep Time: 30 ms to 90 s.

8. Interface: IEEE 488/USB/LAN

9. Operating Temperature Range: 5 to 40 degree C

10. Power Requirement: 230 V +/-10% AC,50 Hz +/- 3%

(D) Power Meter

1. Frequency range	: 10Hz to 40GHz
2. Dynamic range	: >60dB
3. Peak power	: -40 to +20dBm
4. CW measurement	: -70 to +20dBm
5. No of channels	: 2
6. Display	: Graphic LCD
7. Operating temperature	: 0-50 Deg C
8. Cooling	: Fan cooling
9. Storage temp	: -40 to 70Deg C

(E) Digital Multimeter

1. Voltage : DC 600V, AC 600V
2. DC Accuracy : +/- 0.5% + 3 digit
3. AC Accuracy : +/- 1% + 3 digit
4. Resistance : 40 M Ohm
5. Safety ratings : CAT III 600 volts
6. Measurements : AC/DC voltage, resistance, capacitance, diode and continuity test with buzzer

Annexure-5
Format for price bid

SI No	Description	Detailed Item Description	Price in INR
1	Cost of site preparation and civil work for antenna foundation	Table- A	
2	Cost of Antenna & RF subsystem including 3 year onsite warranty as per terms & condition given in Annexure-1	Table- B	
3	Cost of Baseband subsystems for Uplink carrier Option-1: configuration of 4+1(Redundant) Option-2: configuration of 1+1(Redundant) including 3-year onsite warranty as per terms & condition given in Annexure-1 (In case of cost is variable with number of user license then vendor to provide price breakup for 100, 500, 1000, 2000, 5000, 10000, 20000, 50000 & 1 lacs user per gateway)	Table-C	
4	Cost of Hub Monitoring and Control (Hardware and Software) System	Table-D	
5	Cost of 24X7 Gateway operation for 3 years (Provide cost breakup per year) Provide cost break up per person per shift	Table – D1	
6	Cost of 100 Ku-band RUTs (Excluding installation & commissioning and onsite field maintenance) (Installation /Services/CAMC are offered as a zone-wise with Price Breakup)	Table-E1 Table-E2	

7	Cost of Proposed Test and Measurement equipments with list of deliverable	Table-G	
8	Cost of Comprehensive Annual Maintenance Contract (CAMC) of Gateways for three years after warranty - 4 th , 5 th & 6 th years	-	
9	Cost of 24X7 operation for 4 th , 5 th & 6 th years (Provide cost breakup per year)	-	
10	On site CAMC of 100 Ku-Band RUTs for 4 th , 5 th , & 6 th years	Table-E2	
11	Applicable taxes	Table-H	
	Total		

Optional Items:

1. Vendor must accept to provide the following items as per rates below, if ISRO demands within one year after placement of the purchase order:

SN	Item	Unit Price (INR)
1	Delta price for every additional 1 carrier upgradation from configuration (4+1) or (1+1) which shall include warranty in commensurate with gateway elements	
2	Implication on CAMC for 4 th , 5 th & 6 th year due to enhancement of baseband capacity (if any)	

2. Vendor must accept to provide COMC for gateways for 7th, 8th, 9th & 10th year if asked by SAC-ISRO at the end of 6th year:

SN	Item	Cost of Operation (INR)	Cost of Comprehensive Maintenance (INR)
1	COMC for 7 th year		
2	COMC for 8 th year		
3	COMC for 9 th year		

4	COMC for 10 th year		
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3. Vendor must accept to provide the RUTs as per rates below, if ISRO demands within one year after placement of the purchase order (Vendor to quote the RUT prices in slabs as per table below):

SN	No of RUTs	Price with 4W BUC	Price with 2W BUC
1	1-100		
2	101-500		
3	501-1000		
4	> 1000		

Table-A

Site preparation and civil work for antenna foundation

Sl. No.	Description	Qty	Price per unit
1.	Cost of site preparation and civil work for antenna foundation		
1-a	Earth Pits for Antenna, Lightning arrestors Per Antenna 01 Nos	8	
1-b	Chemical Earth Pits for Equipment Room control & RF for Antenna 01 No.	4	
1-c	Cable Trays / Trenches From Antenna to Equipment Room Max. Distance of 100 mtr.	4	
1-d	Site Survey, Detailed Soil testing and Antenna Foundation Pedestal 1.5m Ht. Only from FFL., per Antenna	8	

Note: The activities mentioned in the above table are indicative. However, the vendor shall be responsible for all the works related to site preparation and installation of Gateways, without additional costs.

Table-B

Antenna & RF subsystem

Sl. No.	Description	Qty. per gateway (Main + Diversity)	Total Qty.	Price per unit
1.	Provide list of deliverable for each gateway with quantity per gateway (Specify item required in main & diversity)	1+1		
1.1	For example Item-1	1+1		
1.2	Item-2	1		
1.3		1		
1.4	Item - N	1		

Table-C
Baseband subsystems (Option-1)

Sr No	Baseband subsystems with configuration of 4+1(Redundant) Uplink carrier consisting of the following	Per Gateway	Total Qty	Price per unit
1	Vendor to provide detail list of deliverable with quantity per gateway and total for all four gateway	1	4	
	For example Item-1	1	4	
	Item-2	2	8	
	Item-3			
	Item-N			

Baseband subsystems (Option-2)

Sr No	Baseband subsystems with configuration of 1+1(Redundant) Uplink carrier consisting of the following	Per Gateway	Total Qty	Price per unit
1	Vendor to provide detail list of deliverable with quantity per gateway and total for all four gateway	1	4	
	For example Item-1	1	4	
	Item-2			
	Item-3			
	Item-N			

Purchaser reserved the right to select any one option of baseband configuration at the time of technical evaluation of bid and selected option will be considered for L-1 criteria

Table-D1

Item	Operation cost per shift per person	Operation cost per shift (2 persons per shift)	Operation cost for 24X7
Operation for 1st year			
Operation for 2nd year			
Operation for 3rd Year			
Operation for 4th Year			
Operation for 5th Year			
Operation for 6th Year			

Table-D

Hub Monitoring and Control (Hardware and Software) System

Sl. No.	Description	Qty per gateway	Total Qty	Price per unit
	Vendor to provide detail list of deliverable with quantity per gateway and total for all four gateway			
	For example Item-1	1	4	
	Item-2			
	Item-N			

Table-E1

Price breakup of RUT

SN	Description	Price per unit
1	1.2m Ku- band antenna System	
2	BUC (4W)	
3	BUC (2W)	
4	LNBC	
5	Modem (VSAT IDU)	
6	Cables (30 meter) & accessories	

Note: SAC-ISRO reserves right to order RUTs with 2W/4W BUC with different quantity

Table-E2

Cost of Installation & commissioning and CAMC of 100 Ku-Band RUTs

Zone	Transportation, Installation & commissioning Rupees / unit (Valid for 3 year)	3-year on site CAMC Rupees / unit	On site CAMC for 4 th Year Rupees / unit	On site CAMC for 5 th Year Rupees / unit	On site CAMC for 6 th Year Rupees / unit
Mainland States/UTs					
Andaman & Nicobar Island					
North Eastern States, J&K					

Note: This amount will be paid based on services offered in respective regions

Table-F

Critical spares Proposed by the vendor for during Warranty & COMC for smooth operations (cost to be borne by vendor)

Sl. No.	Description	Qty. per gateway	Total Qty.
	Vendor to provide detail list of deliverable with quantity per gateway and total for all four gateway		
A	Antenna & RF		
	Item-1		
	Item-2		
	Item-N		
B	Baseband		
	Item-1		

	Item-2		
	Item-N		

Table-G

Proposed Test and Measurement equipment with list of deliverable

SN	Description	Make/Model	Qty/Gateway	Total Qty	Price per unit
1	Ka- Band Spectrum Analyzer		1	4	
2	Ka- Band Signal Generator		1	4	
3	Ka- band Power meter		1	4	
4	Oscilloscope		1	4	
5	Digital Multimeter		1	4	

Table-H

Applicable taxes:

SI No	Description	Tax rates	Taxes as per Price in INR
1	Cost of site preparation and civil work for antenna foundation		
2	Cost of Antenna & RF subsystem		
3	Cost of Baseband subsystems with configuration as per Option-1 and Option-2		
4	Cost of Hub Monitoring and Control (Hardware and Software) System		

5	Cost of 24X7 Gateway operation for 3 years (Provide cost breakup per year)		
6	Cost of 100 Ku-band RUTs (Excluding installation & commissioning and onsite field maintenance) (Installation /Services/CAMC are offered as a zone-wise with Price Breakup)		
8	Cost of Proposed Test and Measurement equipments with list of deliverable		
9	Cost of Comprehensive Annual Maintenance Contract (CAMC) of Gateways for three years after warranty -4 th , 5 th & 6 th year		
10	Cost of 24X7 operation for 4 th , 5 th & 6 th year (Provide cost breakup per year)		
11	On site CAMC of 100 Ku-Band RUTs for 4 th , 5 th , & 6 th year		
	Total		

Note: Bidder to provide any other cost not reflecting in above table